Corona Virus - SARS-CoV-2: An Insight to Another way of Natural Disaster

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Abstract

INTRODUCTION: SARS-CoV-2 is the latest virus responsible for an outburst of a unique respiratory infection identified as COVID-19. The virus popularly known as Corona Virus has spread quickly in recent days from China to several other countries around the world. Health is always of prime concern for mankind. Computing is playing an important role in improving the current state of the healthcare industry.

OBJECTIVES: This paper focuses on summarizing the happenings about the coronavirus and the disease spread. This review study concentrates on the history of the virus, its technical details, the disease caused by the virus, its symptoms and precautions. The study also tries to develop an understanding of the role of technology in dealing with the outbreak, its impact in diverse fields, and the current state of the pandemic.

METHODS: This work is an attempt towards presenting a perspective of computing and technology in fighting against the COVID-19 pandemic.

RESULTS: This work presents a perspective showing technology in healthcare as a rescuer in such situations. In this survey, we simply discuss SARS-COV2 and COVID-19 from different perspectives in order to serve as a quick reference for the readers and to achieve a better insight into the fast-evolving pandemic.

CONCLUSION: Social distancing, staying home and lockdowns are some known solutions to combat the pandemic in the absence of the vaccine, and technology can play a significant role in combating the pandemic.

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1. Introduction

At the end of December 2019, several patients with pneumonia of unidentified etiology were reported in Wuhan (the capital city of Hubei Province in China) whose cause was later found to be linked with a wet seafood wholesale market in the region [1]. On the last day of 2019, the Chinese Centre for Disease Control and Prevention forwarded a quick response crew to assist Wuhan's health authorities in conducting an investigation of epidemiologic and etiologic scale. The novel coronavirus is found to be similar to the previously detected beta coronavirus in bats, though it is distinct as of previously known SARS-CoV and MERS-CoV. Coronaviruses are outsized, encased, encircled, positive-strand RNA viruses which are broadly categorized as alpha (α), beta (β), delta (δ), and gamma (γ), in this α and β, CoVs are identified to contaminate humans [2]. SARS CoV-2 is zoonosis i.e. it can spread from animals to humans. Four Human Corona Viruses (H229E, NL63, OC43, and HKU1) are pervasive worldwide in addition to responsible

for 10% to 30% of upper respiratory infections in adults [3]. Based on investigations, the researchers have found 86.9% identical genome of the novel coronavirus to the beta coronavirus which is also found in bats [4]. It can be propagated in the primary human airway epithelial cells. The overall genome organization of the novel coronavirus is alike to other coronaviruses in their family group which means that the open reading frames of the genome sequence of novel coronavirus are encoded just similar to all other beta-coronaviruses. The genome of the novel coronavirus comprises a single, positive-stranded RNA which is approximately 30,000 nucleotides long. The structure of the coronavirus genome and its spikes are shown in figure 1 and figure 2 respectively.
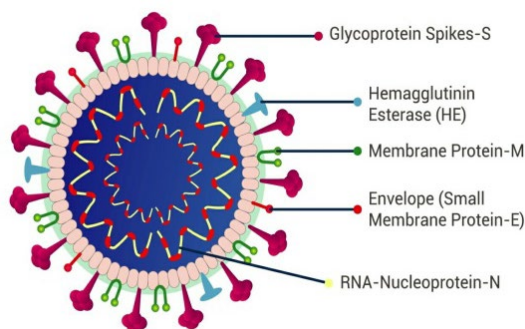
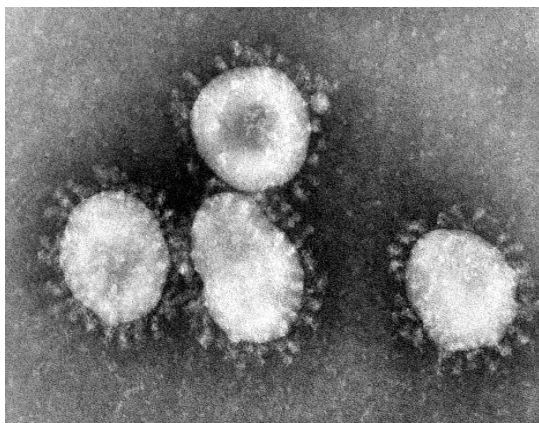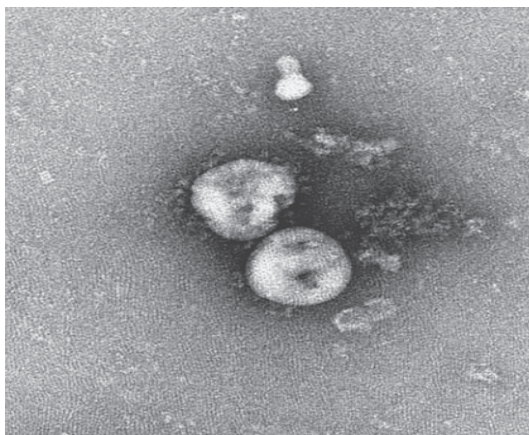

Figure 1. Structure of Coronavirus Genome

Figure 2(a), 2(b). Coronavirus Spikes [1, 10]

The initial experiments to detect the novel coronavirus were done by Zhu et al. and they reported their findings in a brief report in which three cases of severe pneumonia were studied. The initial explanation of cytopathic effects and morphology were also reported. The structure analysis of the Receptor Binding Domain (RBD) of 2019-nCoV has done by Chen et al. within the first forty days of the outbreak. The authors suggested that Angiotensin Converting Enzyme II (ACE-II) from animals of the family of fishes, amphibians, reptiles, birds, bats or other mammals can potentially bind RBD of 2019-nCoV, making them possibly natural hosts for the virus. They further revealed that 2019-nCoV is mainly transmitted through respiratory droplets but can also spread through other possible means like contaminated surface touch. They also insisted upon developing antibodies and small molecular inhibitors to stop the interaction of RBD and ACE2 to contain the virus and its transmission.

1.1 Symptoms

COVID-19 (Corona Virus Disease) can cause an ailment that may extend from mellow to extreme or even dangerous. The symptoms start between 2 to 14 days after one gets tainted; this period is known as the incubation period. The subjects showing symptoms or found positive are being kept under active monitoring or quarantine either in isolation wards or camps under active medical custody. The key symptoms of the disease include fever, chest pain, rapid heartbeat, cough, sore throat, and shortness of breath. Several infected people were found to develop pneumonia in both lungs ranging from mild to severe. In the worst infected cases, severe acute respiratory syndromes and kidney failure were also reported, eventually leading to deaths in numerous cases.

1.2 Infection Spread

This is not the first time any virus has spread so enormously causing mankind to fight against such a "*natural disaster*". MERS in 2002-03, H1N1 influenza in 2009, SARS in 2012 and Ebola outbreak in 2014 were other such instances which forced human to fight against virus spread illness. The common human coronavirus (HCoV) usually causes mild to moderate upper-respiratory ailments, similar to the common cold [8]. The majority of us get tainted with at least one of human coronaviruses (not to be confused with novel coronavirus i.e. SARS-CoV2) at some point of time in our lives.

Two important categories of viral respiratory syndromes are Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). MERS was first reported in Saudi Arabia in 2012; dromedary camels being the major reservoirs of MERS-CoV. The majority of people contaminated with MERS were having fever, hack and brevity of breath; and could not survive. It covered as many as 10 countries in the Arabian Peninsula, and 17 countries outside the Arabian Peninsula (noted as exported or travelled cases). As much as 35% mortality rate was

reported during MERS infection despite rapid risk assessments done during the outbreak. SARS associated coronavirus i.e. SARS-CoV was first reported in Asia in 2003. SARS-CoV was reported to be spread from bats to civet cats and to other animals including humans. The first instances of the virus were reported in Guangdong, China in 2002. The severity of SARS-CoV was limited and confined to a few countries only. Moreover, no new instances of SARS-CoV have been reported till now thereafter. The newly outbreak SARS-Cov2 is a part of a family of viruses named for the effect created by spike proteins on their shells, or capsids; due to the symmetry of the outer layer to the sun's atmosphere known as the corona. Until now, there is no particular medication prescribed to forestall or treat the novel coronavirus. The early risk assessment done about SARS-CoV-2 suggests that its severity was very high in China whereas high in the nearby province of China. The rest of the world found its risk from "Moderate" to "High" as per World Health Organization's global risk assessment report published in January 2020 which went "High" in February and to "Very High" in March. On 30th January, the WHO pronounced the coronavirus flare-up as a Public Health Emergency of International Concern. As far as a brief background of the growth of SARS-CoV-2 and COVID-19 is concerned, since its inception, WHO has presented several situation reports which provide the details about infection spread of the outbreak.

The SARS-CoV-2 also called novel coronavirus (nCov19) has originated in the end days of 2019 in the city named Wuhan of the Republic of China. The symptoms of the disease have been traced back to 8th December 2019 whereas the first case was reported on 31st December 2019. During the initial four days, an aggregate of 44 cases was accounted for with pneumonia of obscure etiology in China. On 11th January, the earliest cause of the till-then unknown disease was known and found to be connected with one of the seafood markets of the city. The very next day, the local officials shared the genetic sequences of the novel coronavirus. The following day, the main imported case (outside the country) was accounted for by the Ministry of Public Health, Thailand. In the initial 20 days, 282 affirmed instances of 2019-nCov were accounted for in China, Thailand, Japan and Korea out of which 98.58% were just from China. Out of 278 confirmed cases, 258 were from Hubei Province only. In the first 20 days of the outbreak, 342 cases and nine deaths were reported. Some of the initial precautionary steps took by the national authorities of China were closing the seafood market for environmental sanitation and disinfection, public education on disease prevention, environmental hygiene steps etc. The Department of Disease Control, Thailand started vigilance and surveillance for fever screening of passengers and travelers from all direct flights from Wuhan to various airports of Thailand. Similar steps were also taken by the Japanese Government and the Republic of Korea health authorities. Till 21st Jan, 2019-nCoV was well spread like an epidemic disease. Out of 314 cases reported, 309 were only from China with 51 were severely ill and 12 were critical. There was another concern in parallel that family members and health workers were also getting infected with the virus from positive cases. Travel histories of almost all residents of china were explored in a quick time. The residents of Wuhan city along with people with working or traveling history of Wuhan city were under special vigilance. Meanwhile, the World Health Organization prepared a disease commodity package for all confirmed cases found. Also, the Research and Development blueprint prepared by the World Health Organization was activated to accelerate diagnostics, vaccines, and therapeutics. The active case findings have been conducted by several countries, with the screening of passengers, air-passengers, crew members etc. The screenings for respiratory symptoms and febrile illnesses were done on a mass scale. The risk communication guidelines (RCG) were communicated and shared with the public as well as all broadcast mediums of communication like the internet, radio, satellite, etc. Also, hotlines were established to immediately report any likely case by various ministries of governments of different countries. Within a short span of time, the novel coronavirus ailment 2019 had spread from China to almost all nations around the world through importation. According to the WHO's circumstance report dated 25th January 2020 [24, 25], an aggregate of 1,965 associated cases and an aggregate with 1,320 affirmed cases were accounted for from twenty diverse Chinese provinces, regions, cities, territories, districts and urban communities. The rate of growth of positive cases increased at an exponential rate in almost all the countries across the globe as shown in figure 3.
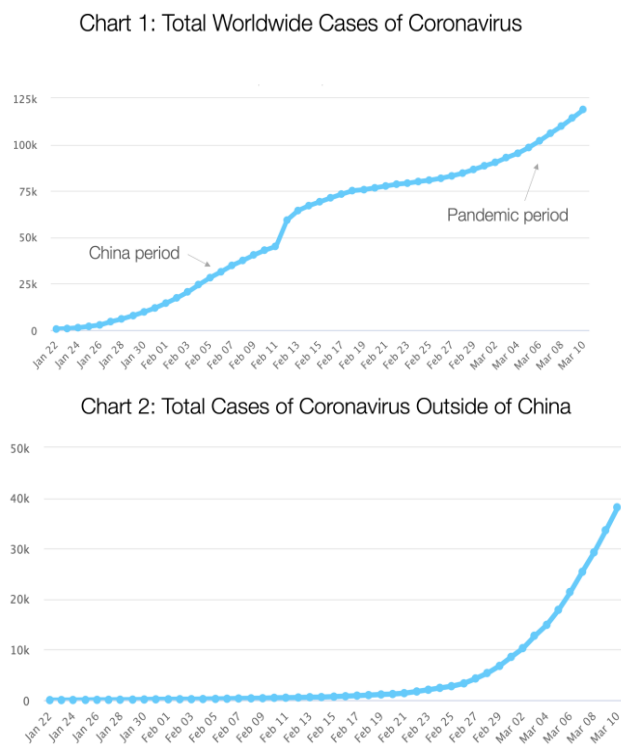

Chart 1: Total Worldwide Cases of Coronavirus

Chart 2: Total Cases of Coronavirus Outside of China

Figure 3(a), 3(b). Exponential Growth of Coronavirus infection spread globally [22].

The scenario continued to exacerbate day by day. The outbreak changed into an epidemic and then pandemic very soon. Several countries have observed exponential growth in the number of new cases, and active cases. Some agencies are supporting researches on novel coronavirus like NIAID [8], CEPI, EMA, NCBI, NCM etc. The Centre for Disease Control and Prevention (CDC) [9], USA is updating the world of the current threads about the novel coronavirus and COVID-19 24x7x365. The total number of cases reported till now worldwide are reported in Table 1[11].

Table 1. Till Date Reporting [22nd May 2020]

Reported	Active	Recovered	Deaths	Critical
5,221,567	2,787,749	2,098,615	335,203	45,498

Though the epicenter of the disease was China yet other major affected countries are the United States of America, Russia, Brazil, Spain, United Kingdom, Italy, France, Germany, Turkey, Iran, India and Peru where more than 0.1 million cases have been reported till 20th May 2020 [24]. The World Health Organization pronounced COVID-19 as a worldwide pandemic on 11th March 2020 [26].

The most striking feature of the novel coronavirus is that it is spreading from one infected person to others in the incubation period and without knowledge of both the parties. Human coronaviruses typically spread from a contaminated individual to others through any of the accompanying methods in particular,

- The droplets spread by cough and sneeze.
- Close individual contact like touch or handshakes.
- Touching face, eyes, or nose after touching a virus-infected object or surface; without washing hands.

1.3 Preventions and Precautions

Some typical recommendations for preventing infection spread are

- Maintaining at least 1-meter distance with anyone.
- Covering face with an elbow while coughing or sneezing.
- Washing hands with soap regularly.
- Avoiding face, eye and nose touch.
- Avoiding less-cooked or raw meat.
- Avoiding unnecessary animal contact.
- Staying quarantine if you are unwell.
- Refrain from smoking.
- Practice physical or social distancing.
- Avoid travel or large gatherings.
- Use alcohol-based sanitizer for cleaning hands and public surfaces and objects.
- Stay home if it is not much necessary to go out.

This paper focuses on summarizing the happenings about the coronavirus and the disease spread and presents some valuable insights, combining many aspects in a single study. The remaining structure of this document is as follows: section II presents a brief literature survey, section III provides a short note on the role of technology in the epidemic, section IV shows the impact of the epidemic in diverse fields. Section V presents the current scenario while Section VI presents the conclusion.

2. Literature Survey

Li et al. [4] conducted a study in 2005 following the SARS emerged in 2002 and 2003 in China in which they reported bats to be natural reservoirs of SARS Coronaviruses. The reservoir hosts of several other zoonotic viruses like Hendra and Nipah that had appeared in past in Australia and East Asia were also bats. Gralinski and Menachery [5] were confident of tackling the return of coronavirus better because of technical advancements and significant lessons learnt from previous outbreaks. They presented their insights about the novel coronavirus and its spread in healthcare settings. They insisted that human to human transmission is a major threat from the current infection. Paules et al. [6] presented a viewpoint in their study about the trajectory of the outbreak, effective response strategy, and apt progress and execution of active countermeasures required to contain the outbreak. The genome of the novel coronavirus was described by [10]. Droston et al. [12] experimented with a random-amplification procedure using polymerase-chain-reaction after isolating the virus in cell-structure. The genetic characterization of the virus depicted that the virus was distantly related to the so-far-known coronaviruses. They concluded that SARS diseases can be caused by the novel coronavirus which was first invented in 2002-03.

Zaki et al. [13] in 2012 investigated an unknown coronavirus (HCoV-EMC); able to replicate radially in cell culture, in the saliva of a 60-year old patient who suffered from "acute pneumonia and subsequent renal failure". The virus was found to produce cytopathogenic effects or structural changes. This virus represented a new beta coronavirus species. The nearest known family members were bat-coronaviruses; "HKU4" and "HKU5". The authors presented the crucial clinical information, infection detachment, and molecular identifications. The results were very much similar to the Severe Acute Respiratory Syndrome (SARS) epidemic happened in 2003. Menachery et al. [14] examined the disease potential of a SARS-like virus SHC014-CoV. These experiments unlocked the potential of using meta-genomics data to envisage and contain the upcoming emerging virus erections due to Chinese horseshoe bat populations and the virus SHC014-CoV. An editorial published on 20th February 2020 [15] extended the understanding of the novel virus and its potential consequences.

A team of nine doctors [16] evaluated thin-section computerized tomography of real-time reverse transcription polymerase chain reaction on a set of 51 patients (25M & 26F). Fifty out of 51 patients were found to be in contact with subjects from the epidemic center. Fever and cough were the most general symptoms found in the patients. Wang et al. [17] presented serological evidence of bat SARS-related coronavirus infections in humans in the form of a letter to the editor of *Virologica Sinica*, Springer Nature. In this work, the authors performed a serological investigation on individuals living in the vicinity of bats' caves where they carry diverse SARSr-CoVs. Zhou et al. [18] reported the identification and characterization of the novel coronavirus of probable bat origin. Upon a detailed investigation of full-length genome sequences of five patients from Wuhan, they found 79.6% similarity of the new virus with SARS-CoV. They also found a 96% similarity of the virus with a bat coronavirus. They also experimented with pairwise protein sequence analysis of

seven conserved non-structural proteins concluding that the SARS-CoV2 also uses the same cell entry i.e. ACE2 as receptor just like SARS-CoV. The authors submitted the sequences generated through their experiments to GISAID [10] (under accession number EPI_ISL_402124).

Gorbalenya et al. [19] answered some vital questions about SARS-CoV2 such as defining novelty and taxonomy of SARS-CoV2. This study emphasizes focusing on pathogens to understanding virus species. Beta-coronaviruses are enveloped non-segmented positive-sense RNA viruses that belong to the family of coronaviruses and are widely spread in humans and other mammals [20]. A summarized view of top publishing researches can be found in [21]. The articles found on LinkedIn and other social media platforms are also catching attention. Table 2 gives an insight into some of the trending publications related to nCov19 i.e. SARS-CoV2 and COVID19 with their key contributions.

Table 2. Some Trending Publications

Authors	Pub. Date	Contribution
Huang et al. [27]	January 24, 2020	Clinical investigations of patients suffering from novel coronavirus were reported for the first time. Patients in the Intensive Care Unit (ICU) had higher plasma levels as compared to Non-ICU patients.
Li et al. [28]	January 29, 2020	Some more detailed investigations and results related to 2019-n-CoV infected Pneumonia (NCIP) were reported.
Holshue et al. [29]	January 31, 2020	The authors reported a detailed case study of the first case of 2019-n-CoV in the United States of America.
Shen et al.[30]	March 27, 2020	Good News: Treatment details of five critically ill patients through convalescent plasma were reported by authors.
Fong et al. [31]	April 9, 2020	Use of AI in predicting the order of growth of the epidemic: A case study with application of Composite Monte Carlo algorithm enhanced by using a deep learning network with fuzzy rule training for achieving improved statistical results in terms of predictions about the potential growth of the epidemic is investigated by authors.
Gao et al. [32]	February 29, 2020	Good News: The Authors reported Chloroquine phosphate showing seeming usefulness in the cure of COVID-19.
Liu et al. [34]	March 12, 2020	The authors reported some interesting results on therapeutic agents and vaccines for COVID-19.
Pirouz et al. [35]	March 20, 2020	Another Perspective of COVID-19 through AI: Authors investigated a predictive analysis of affirmed cases through binary classification using a regression analysis scheme.

Like the growth of confirmed cases of COVID-19, the graph of research publication over coronavirus or COVID-19 also going exponential. To assemble all important publications, several publication agencies have come together. Also, they have made open access to research articles on COVID-19 and coronavirus related topics free. In this context only, The Allen Institute for Artificial Intelligence (A2I) has partnered with the National Library of Medicine (NLM), National Institute of Health (NIH), and Microsoft Inc. to compile and distribute an "Open Research

Dataset for COVID-19" known as CORD-19. The dataset is available on A2I's semantic scholar webpage [23].

3. Role of Technology in Epidemic

Technology has always played a significant role in any circumstances. In this crucial time too, Technology enabled digital tools such as telehealth, remote patient monitoring, data analytics, and even consumer-facing Artificial

Intelligence enabled robots and chatbots are contributing significantly in comprising the flare-up of COVID-19. Earlier instances of using *drones* to spread awareness about the coronavirus, its symptoms, the infection spread, and precautions were seen in Wuhan and other close areas in China. Chinese tech-giants have accelerated their efforts in health-care technology amid the novel coronavirus outbreak. Few examples consist of cloud computing-based analysis of medical images and e-doctor consultation.

Alibaba - an e-commerce giant in China and Baidu - China's most used search engine launched online clinic services and e-doctor consultation platforms for the infected people so that they need not visit doctors physically. As per Baidu, they have tackled 15 million queries so far and more than 1 million doctors have registered and are available to answer online queries. Baidu is also providing a healthcare assistance algorithm (LinerFold) to gene-testing offices, epidemic control, and research centres all around. The algorithm helps scientists to comprehend the hereditary cosmetics of the coronavirus and could assist endeavours with developing an immunization. A real-time fever check facility is being performed in Singapore hospitals by using a smartphone and a thermal sensor. Tancent – video gaming company has launched a free online health consultation service in China. XAG Robot is also deploying disinfectant-spraying robots and drones in Guangzhou, China. Another vital study has published in the context of using digital teaching-learning systems through television broadcasts in china to provide undisrupted education to millions of affected students. The study by Wang et al. [7] also mentioned the side effects of home confinement of children during the epidemic period in the form of increased stress, prolonged fear, frustration, and boredom, etc. due to non-involvement of children in outdoor activities. In this context, *"Emergency Home-schooling Plan"* and the *"Virtual Semester"* are significant exertions by the Chinese Government and Authorities to mitigate the side-effects of students' home confinement.

Healthcare automation using Artificial Intelligence (AI) and Machine Learning (ML) has emerged as a boom gaining sector in the corona crisis. Tele-Health is trending high. Tracing travel history using AI tools, using ML to track contact tracing are examples where technology is remarkably doing well to fight against coronavirus. Many such instances have come into existence in recent real-time, where AI, Machine Learning, and Big Data are being used as a shield against COVID-19. Several instances of technical developments are a morale boost during the pandemic. Disinfecting robots deployed at airports, automatic temperature sensing devices, Arogya Setu App (NIC, GoI, India) which alarms in case any coronavirus infected person is present nearby, Clara – a Chabot for automated symptoms check facility developed by CDC, USA are examples to name a few.

4. Impact of Epidemic in diverse fields

Wuhan – the epicentre of the novel coronavirus epidemic has been in a condition of lockdown for the last two months. The major impacts of pandemics on society can be economic, social, and political. The economic damage through multiple channels in parallel is a common scenario during a pandemic. Individual behavioral change, recession, and credulity are other apparent side effects of such pandemic. Though fear played a major role in the SARS epidemic, yet author in [16] is hopeful of alleviating fear due to lessons from past epidemics and some specific anti-coronaviral therapies in development.

New lifestyles spread diseases further. Most of the epidemics spread so far like Chikungunya, Ebola, Cholera, Plague, Zika, Nipah, MERS-CoV, Lassa fever, Yellow fever, Influenza A, Monkeypox, Nodding syndrome, etc. have emerged due to one or the other of the next mentioned reasons namely; major and unstandardized changes in lifestyle, not following traditional control measures, un-natural, unnecessary and extended contact and the excessive involvement of animals in human life.

The areas of eerie impacts of the pandemic with their consequences are enlisted in Table 3.

Table 3. Areas of Impact of Pandemic and their consequences

Impact	Consequences
Behavioral	Emotional weakness, fear, distress, credulity
Trade and Economics	Economic Slowdown, Financial Crisis, Recession
Mental health	Anxiety, Sleep Disturbance (irregular sleep patterns), Stigma
Physical health	Less physical activity, longer screen timings, weight gain

5. Current State

Some key symptoms of COVID-19 are high fever (i.e. $\geq$ 100.4º F), dry cough, sore throat, and difficulty in breathing. Any patient with these symptoms needs to be treated as per the current healthcare settings available for COVID-19. The disease spreads with contact to coronavirus infected person's droplets on daily-use things, surfaces or physically coming in contact with the infected person itself. Social distancing, isolation and staying at home are the only solution that has been found so far. Several countries have imposed emergency, lockdown and curfews as measures to contain and combat the virus spread disease COVID-19. The suspicious of the infectious disease are quarantining themselves in isolation either themselves or by government initiatives around the world. Several trials for developing a vaccine, tests, and treatments are for the containment of the virus are currently undergoing around the globe. Numerous

rigorous steps have been taken by many countries to stop the infection spread and to control the situation at the earliest. All walks of life such as education, business, sports, tourism and travel have been hit hard by the pandemic. Life during *"lockdown"* in many countries has been extraordinarily silent and challenging. India is also experiencing lockdown these days to avoid bulk damage and fatalities. Infection is spreading steadily from the upper-class community to the lower-class community where the mass destruction from the disastrous will be difficult to contain [36]. The experts are suspecting that the recession is around the corner. The economy of almost all countries in different continents has been shattered by the pandemic. Meanwhile, the world is praying for things to be normal as soon as possible. To break the infection cycle, *"social distancing for all"* is one of the mandatory rules to be followed strictly. Work from Home option is getting attention as never before. Research and Developments with COVID-19 are currently active at an enormous speed.

6. Conclusion

Coronaviruses are enveloped RNA viruses that cause respiratory illnesses of varying severity from the common cold to fatal pneumonia. It is more than just a common cold ranging from respiratory diseases to severe pneumonia. In the age of technology, due to the fast development of genome sequences of the novel virus, the research community was engaged rapidly in providing analysis, simultaneously developing antidotes and diagnostic tests. This is the first time any epidemic was so quickly and so accurately analysed and predicted using machine learning and artificial intelligence paradigms. Many biotech companies are coming with artificially intelligent solutions to speed up the fight against the coronavirus global outbreak. The unique circumstances of the epidemic have made a tremendous interest in online clinical administrations and information. Confinement to homes especially for kids is a serious matter of concern and will have a major impact on their mindset if the epidemic gets prolonged. Some superstitious aspects of such epidemics also exist. A Hollywood based Science fiction movie Contagion is said to have shown an example of the pandemic just similar to COVID-19 in 2011. Till now, a huge amount of literature has been originated by researchers around the globe regarding SARS-Cov2, Coronavirus outbreak, and COVID-19. As of now, many aspects of the coronavirus researches have been unfolded and many are still untouched; such as predicting the impact and spread of the pandemic in upcoming days in the major countries of the world on different scales and different parameters. One piece of advice from authors to the world during a pandemic of such mass scale is to stay away from rumours and do not spread fear. Effective containment can flatten the exponential growth curve of infections due to the pandemic.

In this work, authors have focused on the novel coronavirus, its symptoms, infection spread and precautions. The study also throws some light on the role of technology in dealing with the outbreak. Also, an understanding of the epidemic impact in diverse fields of life has discussed. Recently, Mittal et al. [33] detected pneumonia using convolutions and dynamic capsule routing through chest X-rays. In the future, many more AI, ML, and DL applications and tools will be used for fighting such emergent situations all across the world. Mental Health and Stress Level Patterns during such pandemics can be detected and analysed using artificial intelligence and deep learning.

Conflict of Interest
The authors declare no conflict of interest.

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